

DUCK

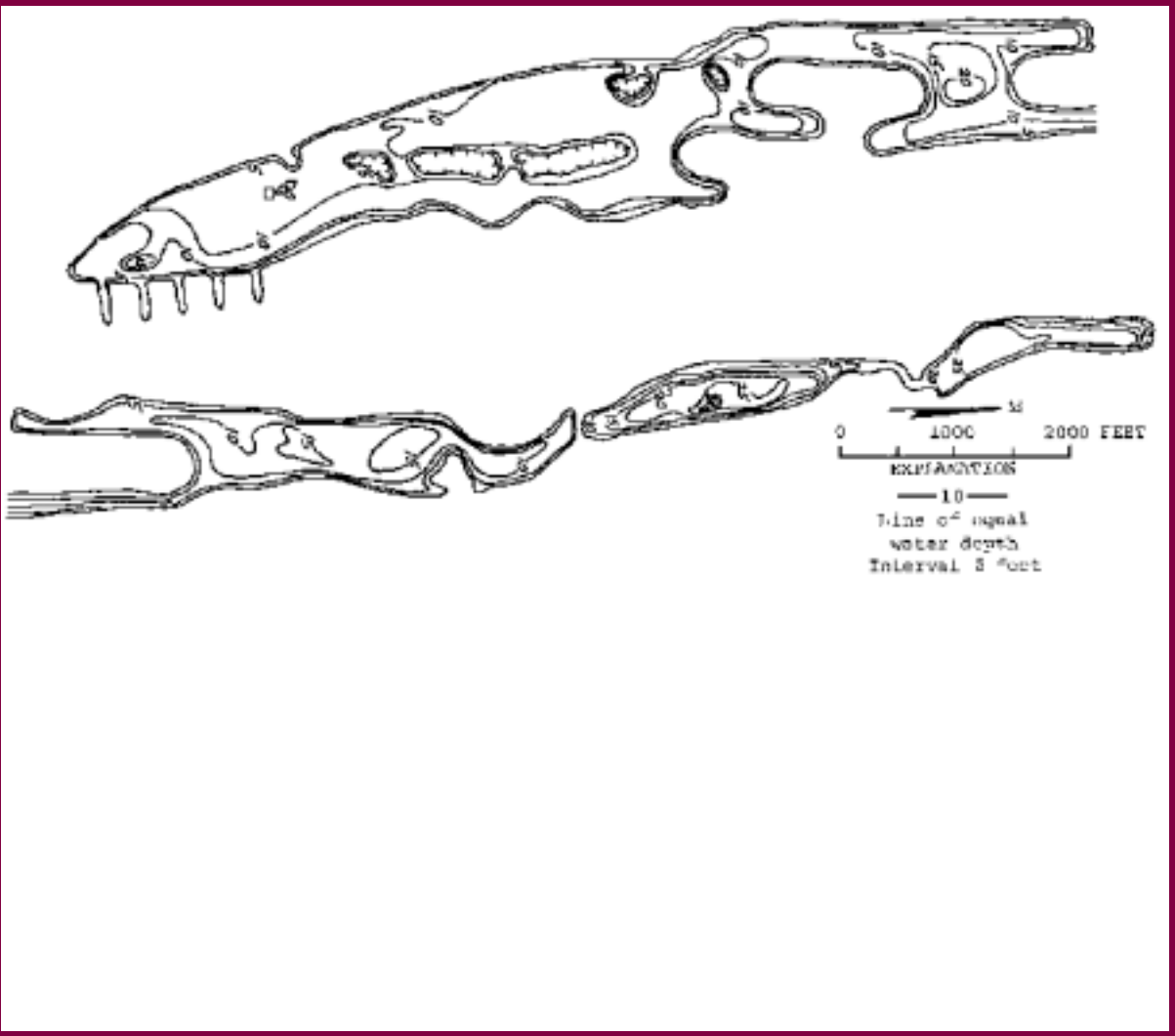
GRAYS HARBOR County

Lake ID: DUCGR1

Ecoregion: 1

Duck Lake is a reservoir just east of the resort city of Ocean Shores. It consists of a series of canals lined with residential homes. At nearly sea level and so close to the ocean, Duck Lake provides a protected haven for many shore birds and other waterfowl.

Area (acres)	Maximum Depth (ft)	Mean Depth (ft)	Drainage (sq mi)	
278	30	11	1	
Volume (ac-ft)	Shoreline (miles)	Altitude (ft abv msl)	Latitude	Longitude
3000	11.3	10	46 57 33.	124 08 12.



## Station Information

DUCGR1

Primary Station	Station # 1	latitude: 46 59 42.5	longitude: 124 08 43.2
	Description:	Deep site. One 'basin' south of northernmost basin of lake. Approximately 1500 feet south of bridge, near east shore.	
Secondary Station	Station # 3	latitude: 46 57 48.4	longitude: 124 08 20.0
	Description:	In southernmost portion of lake, about 2000 feet north of southern tip, and about 400 feet southeast of a major point jutting out into water on west shore.	

## Trophic State Assessment for 1999

DUCK

Analyst: MAGGIE BELL-MCKINNON

TSI_Secchi:	<sup>a</sup>	61	J
TSI_Phos:		57	
TSI_Chlor:		61	
Narrative TSI:	<sup>b</sup>	E	

### Summary Comments:

The general water clarity of Duck Lake was poor in 1999. The Secchi depth readings ranged from 0.8 meters (2.5 feet) to 1.2 meters (4.0 feet) with a mean Secchi depth of 0.9 meters (3.0 feet). For comparison, in 1998 the mean Secchi depth was 2.4 meters (8.1 feet).

Numerous geese and/or other waterfowl were observed on the lake by the volunteer monitor during his sampling visits made between June and September.

The volunteer monitor commented the water color of Duck Lake being a very dark green-brown to dark brown.

The chemistry data collected for Duck Lake showed high phosphorus levels. Values ranged from 32.5 ug/L to 66.5 ug/L in the epilimnion and hypolimnetic readings of 37.0 ug/L to 74.5 ug/L. The chlorophyll levels showed extremely high algae densities in the lake. The phosphorus data indicates a level of productivity where the potential exists for long term algae problems.

Ecology staff made four site visits in 1999. Thermal stratification and low dissolved oxygen levels in the hypolimnion were noted during each of these visits.

Ecology staff conducted an aquatic plant survey on 9/21/1999. The nonnative plant *Egeria densa* (Brazilian elodea) showed thick growth to the exclusion of other species in the lake. Another nonnative species that occurred was *Myriophyllum spicatum* (Eurasian watermilfoil). It had a small and patchy distribution in the lake. Also noted was the large amount of algae growing on the submerged macrophytes.

Based on the Secchi depth data, and the phosphorus and chlorophyll levels, Duck

Lake is classified as eutrophic.

The following is an assessment written by Ecology staff, Sarah O'Neal, to determine the phosphorus criterion for Duck Lake:

Duck Lake is a shallow, densely developed lake in Ocean Shores. Dredging and filling expanded the lake in the early 1960s to create land suitable for development. This led to a disproportionate amount of shoreline relative to a small lake area. It additionally allowed for an overwhelming amount of development on the lakeshore. This development likely led to high nutrient levels, typical of an eutrophic system. The lake did not exhibit increasing nutrient loading in 1999. In fact, nutrients were much lower than in a 1990 Ecology study, perhaps due to the creation of a municipal sewer system in the City of Ocean Shores, though most survey respondents reported a decline in water quality. At the time of sampling, the most significant problems in the lake resulted from dense plant and algae growth. Two non-native noxious weeds, Brazilian elodea (*Egeria densa*), and Eurasian watermilfoil (*Myriophyllum spicatum*) grew in the lake. The Brazilian elodea, in particular, dominated the plant community to the exclusion of other submerged species in many areas of the lake. Algae also grew densely throughout the summer. Both Diquat and copper sulfate were used to control plant and algae growth in the late 1980s, and an Aquatic Plant Management Plan was developed in 1994 which involved mechanical harvesting, grass carp planting, and hand removal of plants. Unfortunately, these methods appear to us to have had little affect. Dense vegetation surrounds the shoreline. Fortunately, native reeds dominated the shoreline plant community, providing some buffer between lawns and lake water, as well as a barrier to boat wakes.

Twenty-one visitors and residents completed the questionnaire. They indicated types of watercraft, water quality, plants, and swimming opportunities all impaired enjoyment of the lake. Two respondents specifically mentioned a desire to restrict personal watercraft. Primary uses among respondents included fishing, canoeing, kayaking, and watching wildlife. Respondent comments, site visits, and other studies clearly revealed that water skiing, jetskiing, swimming, and irrigation were among other uses. Fish habitat in the lake consisted mainly of plants, as well as some overhanging vegetation and human structures. Anoxia in the lake bottom, particularly later in the summer, created poor habitat for coldwater fish such as trout, though surface waters were not excessively warm. The zooplankton community, however, decreased in average size over the course of the summer, indicating utilization by planktivores and possibly inadequate numbers of piscivores. According to WDFW, poor water quality in Duck Lake limited its fishery to primarily warmwater species including largemouth bass, black crappie, bluegill, and pumpkinseed. Prior to sampling, the lake had not been stocked with trout due to a higher angler demand for bass.

Nutrient levels in the lake were within reasonable ranges considering the lake's wetland origin. In addition, the lake's eutrophic state somewhat supported its primary

uses. However, dense plant and algae growth clearly impacted the majority of those uses. Consequently, we recommend a total phosphorus criterion for the lake of 47.2 ug/L (mean 39.3 ug/L plus standard deviation of 7.9 ug/L) as well as continued, perhaps more aggressive, efforts to manage the lake vegetation. Due to the limitations of the sampling conducted during this study, it is difficult to determine whether nitrogen is also limiting to the system. Future studies should investigate the possibility of nitrogen limitation and propose a nitrogen criterion if appropriate.

Mean Secchi = 0.91m; Mean TP = 39.3 ug/L; Mean Chl = 22.0 ug/L; The Secchi TSI is qualified due to duplicate Secchi readings failing to meet quality assurance requirements.

<sup>a</sup> TSI Qualifiers: B or W-Secchi Disk hit bottom or entered weeds; J-Estimate; N-Fewer than the required number of samples

<sup>b</sup> E=eutrophic, ME=mesoeutrophic, M=mesotrophic, OM=oligomesotrophic, O=oligotrophic

## Chemistry Data

DUCK

Date	Time	Strata	Tot P (ug/L)	Tot N (mg/L)	TN:TP	Chloro- phyll (ug/L)	Fecal Col. Bacteria (#/100mL)	Hardness (mg/L)	Calcium (ug/L)	Turbidity (NTU)
<b>Station 1</b>										
6/5/1999		E	66.5	.505	8	15.7				
		H	74.5	.257	3					
7/5/1999		E	45.6	.507	11	45.3				
		H	44.1	.291	7					
8/3/1999		E	35.9	.497	14	18				
		H	37.3	.509	14					
9/15/1999		E	32.5	.439	14	15.7				
		H	37	.612	17					
<b>Station 2</b>										
6/5/1999		E	47.2	.611	13	19.9				
7/5/1999		E	35	.6	17	27.8				
9/15/1999		E	41.7			9.6				

Strata: L=lake surface, E=epilimnion, H=hypolimnion; Qualifier: J=Estimate, U=Less than, G=Greater than.

## Watershed Survey

DUCK

Survey Date: 9/15/1999

Land Uses (1 = Primary, 2 = Secondary, etc.)

☐ Agriculture(commercial, not hobby)

☐ 1 Residential

☐ Commercial, Industrial

☐ 2 Park, forest or natural

☐ Major transportation

Impervious surfaces (Roads and parking area): No Curbs

### Observations (check mark denotes presence)

**BMP's** ☒

Native reeds allowed to grow along most of the shoreline

**Odors** ☐

None

**Cattle** ☐ **Ducks** ☐ **Geese** ☒

Geese in the lake. Hundreds of gulls too

**Fertilizers and weed killers appear to be used in residential or agriculture area** ☐

None

**Buffer zones around streams and wetlands** ☒

**Irrigation** ☐

Survey Id: 30

## Habitat Survey Summary Report

DUCK

Data are averages of 10 Stations Surveyed

Date of Visit: 9/21/1999

### Vegetation Type (Avg. only of sites w/ vegetation present; 1=coniferous, 3=deciduous)

Canopy Layer Avg:	2.3	Number of stations with canopy:	7
Understory Avg:	2.6	Number of stations with understory:	10

### Percent Areal Coverage (0 = absent, 1 = <10%, 2 = 10-40%, 3 = 40-75%, 4 = >75%)

Canopy Layer:	trees > 0.3 m DBH	0.9
	trees< 0.3 m DBH	1.2
Understory:	woody shrubs saplings	2.3
	tall herbs, forbs grasses	1.3
Ground Cover:	woody shrubs seedlings	1.9
	herbs, forbs, grasses	3.1
	standing water or inundated veg	0.0
	barren or buildings	1.3
Substrate Type (within shoreline plot):	bedrock	0.0
	boulders	0.0
	cobble/gravel	0.0
	loose sand	0.0
	other fine soil/sediment	0.9
	vegetated	3.5
	other	0.9

Bank Features:	angle (0:<30; 1: 30-75; 2:nr vertical)	0.9
	vertical dist (M from wtrln to high wt):	0.3
	horiz. dist. (M from wtrln to high wt):	0.1
<b>Human Influence</b> (0 = absent, 1 = adjacent to or behind plot, 2 = present within plot)		
	buildings	1.3
	commercial	0.0
	park facilities	0.0
	docks/boats	1.4
	walls, dikes, or revetments	0.6
	litter, trash dump, or landfill	0.0
	roads or railroad	0.0
	row crops	0.0
	pasture or hayfield	0.0
	orchard	0.0
	lawn	1.2
	other	0.0
<b>Physical Habitat Characteristics</b>		
	station depth (m; at 10 m from shore)	2.2
<b>Bottom Substrate (0 = absent, 1 = &lt;10%, 2 = 10-40%, 3 = 40-75%, 4 = &gt;75%)</b>		
	bedrock	0.0
	boulders	0.0
	cobble	0.0
	gravel	0.0
	sand	2.0
	silt	3.1
	woody debris	0.1
<b>Macrophyte Areal Coverage (0 = absent, 1 = &lt;10%, 2 = 10-40%, 3 = 40-75%, 4 = &gt;75%)</b>		
	submergent	3.3
	emergent	1.9
	floating	0.4
	total weed cover	3.5
	Do macrophytes extend lakeward (-1 = yes, 0 = no)	-0.9
<b>Fish Cover (0 = absent, 1 = Present but sparse, 2 = moderate to heavy)</b>		
	aquatic weeds	2.0
	snags	0.0
	brush or woody debris	0.0
	inundated live trees	0.0
	overhanging vegetation	1.1
	rock ledges or sharp dropoffs	0.3

Questionnaire DUCK

**Did the following add (+1), detract (-1), or have no effect (0) on your enjoyment of the lake today?**

**On a scale of 1 (poor) to 5 (excellent), how would you rate water quality today?** 2.1

1) Better fishing and more natural habitat, or 2) clearer water?	1.5
1) Better fishing and more natural habitat, or 2) fewer aquatic plants?	1.3
1) Clearer water, or 2) fewer aquatic plants?	1.2

Restricted Watercraft:	4.0	Good Warmwtr Fishing:	4.1	Natural Scenery:	4.2
Plant Growth:	2.4	Good Swimming:	3.7	Public Beach:	3.1
Natural Shoreline:	3.9	Less Algae:	4.4	Canada Geese:	3.0
No Odors:	4.1	Public Access:	3.3		
Good Coldwtr Fishing:	3.8	Clear Water:	4.3		

Survey ID	Date	Residency	Rent or Own	Primary Activity*	-----Water Clarity-----		
					Purchase Factor?	Has it Changed?	When?
89	6/15/1999	Visitor		1	<input type="checkbox"/>	Unknown	
135	6/15/1999	Resident	Permanent	Rent	1	<input type="checkbox"/>	Worse 1994
140	6/14/1999	Resident	Permanent	Rent	2	<input type="checkbox"/>	Worse
142	6/12/1999	Visitor		2	<input type="checkbox"/>	No	
143	6/14/1999	Visitor		2	<input type="checkbox"/>	Unknown	
144	6/12/1999	Resident	Permanent	Rent	2	<input checked="" type="checkbox"/>	Unknown
	Would like to see personal watercraft banned and have payboxes for boat launch.						
148	6/8/1999	Resident	Permanent	Rent	2	<input type="checkbox"/>	Worse 1995
	More grass carp please!						
150	6/8/1999	Resident	Permanent	Rent	3	<input checked="" type="checkbox"/>	No
152	6/8/1999	Resident	Permanent	Rent	7	<input type="checkbox"/>	Worse 1998
154	6/7/1999	Resident	Permanent	Rent	1	<input type="checkbox"/>	Worse
156	6/7/1999	Resident	Permanent	Rent	7	<input type="checkbox"/>	Worse 1991
157	6/8/1999	Resident	Permanent	Rent	7	<input type="checkbox"/>	Worse 1991
158	6/5/1999	Resident		Rent	4	<input type="checkbox"/>	Worse 1998
159	6/5/1999	Visitor		2	<input type="checkbox"/>	Unknown	
	No Jet Skiis						

160	6/7/1999	Resident	Permanent	Rent	1	<input checked="" type="checkbox"/>	Unknown	
163	6/19/1999	Visitor			1	<input type="checkbox"/>	Worse	
171	6/16/1999	Visitor			2	<input type="checkbox"/>	Unknown	
172	5/29/1999	Resident	Permanent	Rent	2	<input checked="" type="checkbox"/>	Worse	
183	7/6/1999	Resident		Rent	2	<input type="checkbox"/>	No	
Upland property owners have been allowed to remove natural shoreline and replace with lumber or rock--habitat complexity is disappearing at an alarming rate.								
191	7/12/1999	Resident	Seasonal	Rent	2	<input type="checkbox"/>	Unknown	
213	7/12/1999	Visitor			1	<input type="checkbox"/>	Worse	1992

\* 1=canoe/kayak, 2=fish, 3=pers. wtrcrft, 4=mtrboat, 5=sail, 6=swim/wade, 7=watch wldlf, 8=ski, 9=windsurf, 10=relaxing

## Zooplankton Report

DUCGR1

Date 6/5/1999 Station: 1 Length of tow not labelled. Some algae and rotifers in sample.  
Sample ID 80

Number of organisms measured: #Delet

Group	Percent	Group	Percent
Cladocera	#Deleted	Small < 1mm	#Deleted
Copepod	#Deleted	Large >= 1mm	#Deleted
Other	#Deleted	Ratio of large to Smal	#Num!
		Average size (mm):	0.67

Date 6/5/1999 Station: 3 Extremely dense algae. Length of tow not labelled.  
Sample ID 71

Number of organisms measured: #Delet

Group	Percent	Group	Percent
Cladocera	#Deleted	Small < 1mm	#Deleted
Copepod	#Deleted	Large >= 1mm	#Deleted
Other	#Deleted	Ratio of large to Smal	#Num!
		Average size (mm):	0.86

Date 8/3/1999 Station: 1 About .25 mL measured (very dense sample). Stringy brown algae was extremely  
Sample ID 36 dense, making ID difficult. Sample was taken from boat launch, but length of tow was not labelled.

Number of organisms measured: #Delet

Group	Percent	Group	Percent
Cladocera	#Deleted	Small < 1mm	#Deleted
Copepod	#Deleted	Large >= 1mm	#Deleted
Other	#Deleted	Ratio of large to Smal	#Num!
		Average size (mm):	0.32

## Aquatic Plant Data

DUCK

Sampler: Parsosns, O'Neal

Survey Date: 9/21/1999

Max depth of growth (M): 3

Comments Sunny, breeze. Habitat survey, quickly motored along parts of shoreline to save time.  
Egeria dense, but ~1-2 feet below surface, maybe from harvester? Much algae growing on plants.

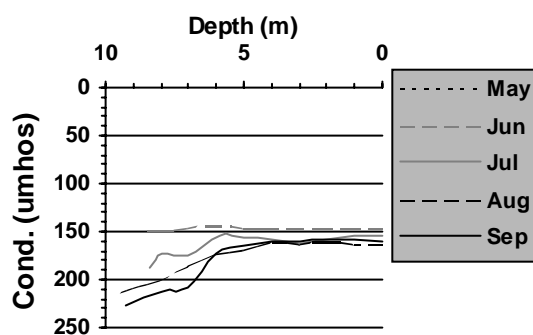
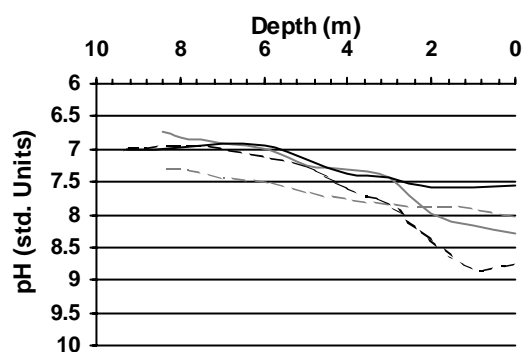
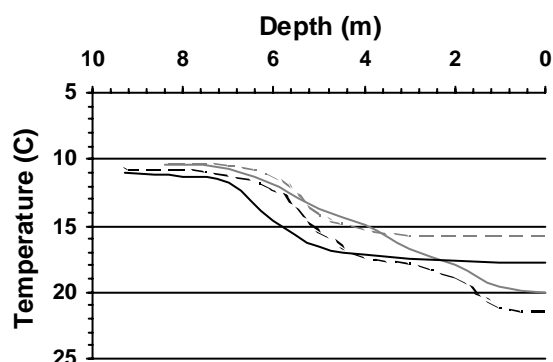
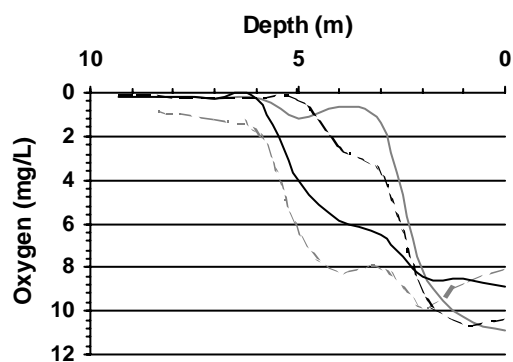
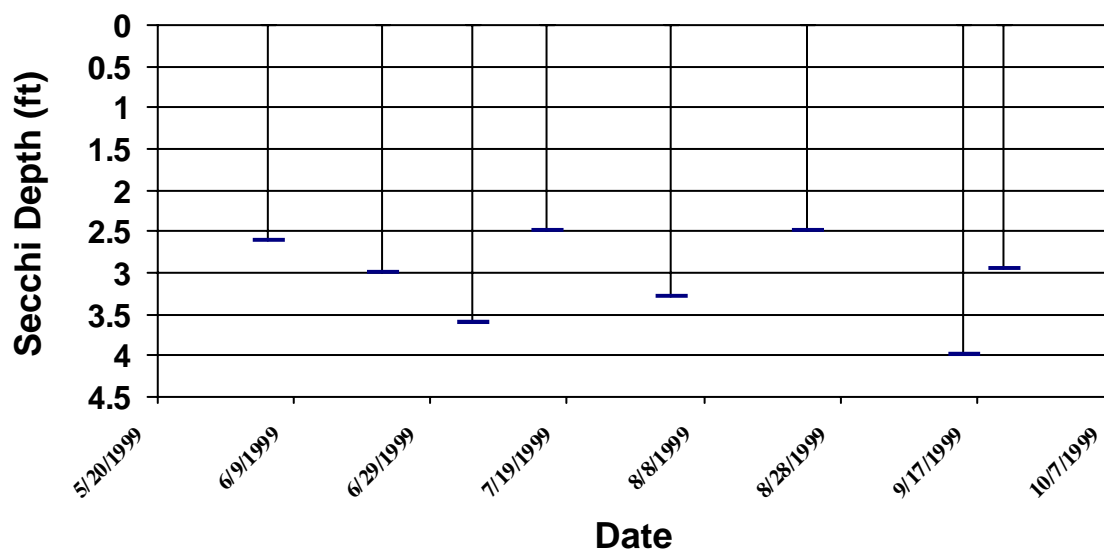


SPECIES LIST			
Scientific Name	Common Name	Dist <sup>a</sup>	Comments
<i>Egeria densa</i>	Brazilian elodea	5	blooming at south end
<i>Elodea canadensis</i>	common elodea	2	
<i>Elodea nuttallii</i>	Nuttall's waterweed	1	
<i>Iris pseudacorus</i>	yellow flag	1	
<i>Juncus sp.</i>	rush	1	
<i>Myriophyllum spicatum</i>	Eurasian water-milfoil	2	
<i>Nitella sp.</i>	stonewort	1	
<i>Nuphar polysepala</i>	spatter-dock, yellow water-lily	2	
<i>Polygonum sp.</i>	smartweed	2	not sure of species, may be hydropiper
<i>Pontederia cordata</i>	pickerel-weed	1	?? One large plant in front of a house
<i>Potentilla palustris</i>	purple (marsh) cinquefoil	2	
<i>Potamogeton pectinatus</i>	sago pondweed	1	
<i>Sparganium eurycarpum</i>	broadfruited bur-reed	4	along shore
<div> <div> <sup>a</sup> 0 - value not recorded (plant may not be submersed)  2 - few plants, but with a wide patchy distribution  4 - plants in nearly monospecific patches, dominant </div> <div> 1 - few plants in only 1 or a few locations  3 - plants in large patches, codominant with other plants  5 - thick growth covering substrate to exclusion of other species </div> </div>			

# Secchi Depth and Profile Graphics

Station: 1

DUCGR1



## Secchi Data and Field Observations

DUCK

Date	Time	Temp- erature (F)	Secchi (ft)	Color (1-greens, 11-browns)	Bright- ness (pct)	Wind (1-none, 5-gusty)	Rainfall (0-none, 5-heavy)	Aesthetics (1-bad, 5- good)	Swimming (1-poor, 5- good)	Geese (#)	Waterfowl (besides geese #)	Boats- Fishing (#)	Boats- Skiing (#)
Station 1													
6/5/1999			2.62	7	50	2	1	4	2	24	1	0	0
	Sampler: SMITH			Remarks: Lots of brownish growth in the water--could be some type of iron bacteria. Dissolved oxygen measurement qualified as an estimate due to calibration failing QA/QC requirements.									
6/22/1999		66	3	5	25	2	3	2	1	0	5	0	0
	Sampler: MARCHBANK			Remarks: Did not use a view tube.									
7/5/1999			3.61	7	0	4	1	4	2	0	0	5	5
	Sampler: SMITH			Remarks: Lots of Brazilian elodea fragments in water. Was so thick that the motor started over-heating.									
7/16/1999		64	2.5	5	75	2	1	2	1		4	3	0
	Sampler: MARCHBANK			Remarks: Did not use a view tube. Water color is close to "11", it is very green-brown.									
8/3/1999			3.3	7	0	3	1	5	4	0	1	0	0
	Sampler: SMITH			Remarks: Water very clear compared to the murky iron color seen earlier in the year. Less Brazilian elodea floating around. H2S at 9 meters.									
8/23/1999		67	2.5	5	25	3	1	2	1	0	0	2	0
	Sampler: MARCHBANK			Remarks: Did not use a view tube. Brown water.									
9/15/1999			4	6	100	1	2	5	2	65	8	2	0
	Sampler: MARCHBANK			Remarks:									
9/21/1999			2.95										
	Sampler: Parsons			Remarks:									
Station 2													
6/5/1999			3.3	6									
	Sampler: SMITH			Remarks: Water more green than brown. Bottom covered with Brazilian elodea.									
9/15/1999		65	7	6	100	1	1						
	Sampler: MARCHBANK			Remarks:									
Station 3													
6/22/1999		69	3.5	5	25	2	3	2	1	0	4	1	0
	Sampler: MARCHBANK			Remarks: Did not use a view tube.									

Date	Time	Temp- erature (F)	Secchi (ft)	Color (1-greens, 11-browns)	Bright- ness (pct)	Wind (1-none, 5-gusty)	Rainfall (0-none, 5-heavy)	Aesthetics (1-bad, 5- good)	Swimming (1-poor, 5- good)	Geese (#)	Waterfowl (besides geese #)	Boats- Fishing (#)	Boats- Skiing (#)
7/16/1999		64	4	5	75	2	1	3	2	14		0	0
	Sampler: MARCHBANK			Remarks: Did not use a view tube.									
8/23/1999		70	7	5	25	3	1	3	3	0		1	0
	Sampler: MARCHBANK			Remarks: Did not use a view tube.									